

**Part 1. Report Cover**

**Retest Report Number:** N/A

**Retest Report Date(s):** N/A

**Replacement Report Number(s):** N/A

**Original Report Number:** 99AYP003A

**Original Report Date:** 23 August 1999

**Revision Date(s):** N/A

**Title:** Performance Oriented Packaging Testing of Packaged  
Solids (57 lb Gross) in a Depot-Made Grade V3c  
Fiberboard, Style RSC Box, 12 inches by 12 inches by  
12 inches (ID), Sealed With Film-Backed Tape - Packing  
Groups I, II, and III (All Modes)

**Performing Activity:** LOGSA Packaging, Storage,  
and Containerization Center  
ATTN: AMXLS-T  
11 Hap Arnold Boulevard  
Tobyhanna, PA 18466-5097

**Responsible Individual:** Francis S. Flynn

**Performing Activity's Reference(s):** 9HTNR;  
AMC 13-88

**Report Type:** Interim Final

**DTIC Distribution:** N/A

**Requesting Organization(s):**  
Defense Logistics Agency  
Defense Distribution Center  
ATTN: DDC-TO  
2001 Mission Drive  
New Cumberland, PA 17070

**Requesting Organization's Reference(s):**  
Memorandum, DOSO-DH, subject: Performance Oriented Packaging  
Tests to be Performed in 1999, 1 Oct 98

**Part 2. Test Results:** \_\_\_ single X combination \_\_\_ composite

**Section I. Pre-test Conditions**

For initial testing of this configuration, two boxes were received in new condition, from the post box fabrication shop. A different type tape was to be used with each box.

The following identification schema designates the packaging specimen used for the test(s) indicated. Assignments were made at random, in no particular order of sequence.

<u>Specimen No.</u>	<u>Test</u>
A	stack test
	repetitive-shock vibration test
	flat onto bottom, drop test
	flat onto top, drop test
	flat onto long side, drop test
	flat onto short side, drop test
	bottom corner, drop test
B	water absorptivity test

Part 2. Test Results: \_\_\_ single X combination \_\_\_ composite

## Section II. Summary

	<u>SPECIMEN</u>	<u>ALL</u>
<b>A. Drop test</b> - 1.8 m (PG I SG 1.2, PG II SG 1.8, PG III SG 2.7)		<b>PASS</b>
flat onto the bottom (face 3)	PASS	
flat onto the top (face 1)	PASS	
flat onto the long side (face 4)	PASS	
flat onto short side (face 6)	PASS	
bottom joint corner (5-2-3)	PASS	
<b>B. Leakproofness test</b> - restrained under water/soap over seams		N/A
production testing, 20 kPa, 5 min.	N/A	
design qualification, 20 kPa, 5 min.	N/A	
salvage drum requirement, 20 kPa, 5 min.	N/A	
<b>C. Internal pressure/Hydrostatic pressure test</b> (liq.) -		
95 kPa		N/A
<b>D. Stacking test</b> - static load, 600 lb, 24 hr		<b>PASS</b>
<b>E. Vibration standard</b> - repetitive-shock, rotary motion		
3.42 Hz., 1 hr		<b>PASS</b>
<b>F. Water resistance test</b> (fiberboard box) -		<b>PASS</b>
<b>G. Compatibility test</b> (liq. in plastics) -		N/A

To be certifiable, the configuration must pass the applicable tests for the type packaging, intended lading, and mode(s) of shipment. This report is ~~is not~~ applicable to transportation by air, and ~~is~~ is not applicable to liquids.

**Part 2. Test Results** (continued)**Section III. Discussion**

Note. Alpha designations denote which specimen tested in that orientation.

**A. Drop test:** 49 CFR §178.603

- ☐ cold conditioned (0° F, 72 hr)  
☐ ambient conditions  
☒ standard conditions (50% RH & 23° C)

No.	Ht.	Orientation	Results
A <sup>1</sup>	1.8 m	Flat onto box bottom	Pass. No leaks/rupture; entire contents retained
A <sup>1</sup>	1.8 m	Flat onto box top	Pass. No leaks/rupture; entire contents retained
A <sup>1</sup>	1.8 m	Flat onto box long side	Pass. No leaks/rupture; entire contents retained
A <sup>1</sup>	1.8 m	Flat onto box short side	Pass. No leaks/rupture; entire contents retained
A <sup>1</sup>	1.8 m	Diagonally onto bottom joint corner	Pass. Minor crushing of the 5-2-3 corner; batteries retained completely within the box.

Note 1. Specimen A, combination packaging consisting of a grade V3c fiberboard, style RSC box (outer packaging) containing packaged solids (55 lb).

**B. Leakproofness test:** 49 CFR §178.604

N/A. Leakproofness testing is not required for configurations of solids.

**C. Internal Pressure/Hydrostatic Pressure test:** 49 CFR §178.605

N/A. Testing for the maintenance of internal pressure is not required for configurations of solids.

**D. Stacking test:** See 49 CFR §178.606.

- ☒ standard conditions (23° C & 50% RH)  
☐ ambient conditions ( ~72° F )  
☐ high temperature conditions (104° F)

No.	Length	Type	Load/Force	Peak Force	Results	Stability Maintained?
A <sup>1</sup>	24 hr	Static	600 lbf <sup>2</sup>	N/A lbf	Pass. No leakage	Yes

Note 1. Specimen A, grade V3c fiberboard, style RSC box, tested empty.

Note 2. The minimum top load (513 lb) to be applied was greater than the minimum required for the configuration packed with solids.

**Part 2. Test Results: Section III (continued)****E. Vibration test:** See 49 CFR §178.608.

No.	Frequency	Duration	Results
A <sup>1</sup>	3.42 Hz	1 hr	Pass. No leakage, rupture, or damage <sup>2</sup>

Note 1. Specimen A, a combination packaging consisting of a grade V3c fiberboard, style RSC box (outer packaging) containing packaged solids (55 lb).

Note 2. The box remained closed, and the contents were completely retained inside the box. The box was not opened before proceeding to the drop test. With the use of a generic product, it was not possible to evaluate whether any actual hazardous lading could leak under conditions of repetitive-shock vibration.

**F. Water resistance (Cobb Method) test** (fiberboard): As required by the standards for fiberboard boxes (49 CFR §178.516), the Cobb Method Test for water absorptiveness was performed on specimens cut from the three boxes used for test reports 99AYP003B, 99AYP004B, and 99AYP005B. The results are combined. These boxes had previously been tested for rough handling (drop, stack, and vibration) testing.

No. specimens felt side (exterior) 10. Average 119.2 g/m<sup>2</sup>.  
Standard deviation 7.11. Highest exterior value was 129.0 g/m<sup>2</sup>.  
Lowest exterior value was 109.0 g/m<sup>2</sup>. All of the samples tested were free of printing.

No. specimens wire side (interior) 0. Average \_\_\_\_\_ g/m<sup>2</sup>.  
Standard deviation \_\_\_\_\_. Highest interior value was \_\_\_\_\_ g/m<sup>2</sup>.  
Lowest interior value was \_\_\_\_\_ g/m<sup>2</sup>.

No. specimens exceeding 155 g/m<sup>2</sup> 0.

It should be noted that improper storage and rough handling may break the fibers and abrade the coating of the box, decreasing its ability to resist water absorption. This could result in higher test values. Since boxes are occasionally made with the wire facing (interior) as the exterior side of the box, specimens from both the wire (interior) and the felt (exterior) facings may be tested for water absorptiveness.

**G. Compatibility test** (plastics packagings only): N/A  
Compatibility testing (a procedure specified in appendix B to part 173, as required by 49 CFR §173.24(e)(3)(ii)) is only required for plastics packagings intended to contain *liquid* hazardous materials.

**Part 2. Test Results** (continued)

**Section IV. Notes**

**Transportation of liquids is not authorized.**

Variation 4 for selective testing of combination packagings, found in 49 CFR §178.601(g)(4), authorizes each external dimension (length, width, and height) to be less than or equal to the corresponding dimension of the tested design type. This allows lessening of the dimensions to provide a snug fit around the packaged lading. The gross weight of the packaging must not exceed the tested weight, and the thickness of cushioning cannot be less than the thickness used in the tested configuration.

**Part 3. Test Personnel**

- A. Drop test** (49 CFR §178.603)
- B. Leakproofness test** (49 CFR §178.604) - N/A
- C. Internal pressure/Hydrostatic pressure test**  
(49 CFR §173.27 & §178.605) - N/A
- D. Stacking test** (49 CFR §178.606)
- E. Vibration standard** (49 CFR §178.608)
- F. Water resistance standard** (49 CFR §178.516)
- G. Procedure for Testing Compatibility and Rate of Permeation  
in Plastic Packaging and Receptacles**  
(49 CFR §173.24, app B to part 173) - N/A

The personnel who performed the aforementioned testing, or had a role in the testing, evaluation, and/or documentation, as reported herein are recorded in the test files.

**Part 4. References**

**A. Title 49 Code of Federal Regulations, Parts 173 and 178,** October 1, 1998 edition

**B. International Air Transport Association Dangerous Goods Regulations,** 40th edition, 1 January 1999

**C. ASTM D 4919,** Specification for Testing of Hazardous Materials Packagings

**D. ASTM D 999,** Standard Method for Vibration Testing of Shipping Containers

**E. ASTM D 951,** Standard Test Method Water Resistance of Shipping Containers by Spray Method

**F. TAPPI Standard: T 441** Water Absorptiveness of Sized (Non-Bibulous) Paper and Paperboard (Cobb Test)

**G. Recommendations on the Transport of Dangerous Goods,** sixth revised edition, United Nations, New York, 1990

**H. DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/MCO 4030.40A,** Packaging of Hazardous Material, 23 Jul 96



**Part 5. Equipment**

Item	Manufacturer	Serial No.	Calibration
			Expiration Date
6-inch dial calipers	Brown & Sharp Switzerland	599-5794	2/00
1,250-lb vibration table	L.A.B Skaneateles, NY	8120179	see note
4,000-lb vibration table	Gaynes Engr. Co. Franklin Park, IL	G20765	see note
12,000-lb vibration table	M/RAD Woburn, MA	563-84	see note
30,000-lb compression tester	Gaynes Engr. Co. Franklin Park, IL	G20950	4/00
5,000-lb compression tester	L.A.B Skaneateles, NY	1107050	4/00
10,000-lb scale	J.J. McIntyre & Sons Whitehall, PA	5931A	4/00
5,000-lb scale	Fairbanks Scale USA	H519240	4/00
500-lb scale	Toledo Scale Worthington, OH	N/A	4/00
5,000-gram scale	Ohaus Corporation USA	20078	N/A (new)
3,000-gram balance	Brinkmann Instruments Westbury, NY	3103120	4/00
release hook	Gaynes Engr. Co. Franklin Park, IL	18211-1	N/R
drop tester	L.A.B Skaneateles, NY	3811	N/R
cold chamber	Russells Holland, MI	1962214	4/00
altitude chamber	American Research Corp. Farmington, CT	5A13622	4/00
32-channel chart recorder	Molytek, Inc. Pittsburgh, PA	870403007-2S	5/99
Cobb Sizing Tester	Teledyne Curley Troy, NY	4180-A	N/R
30 psi pressure gauge	WIKA Instrument Corp. Lawrenceville, GA	961420001	4/00
100 psi pressure gauge	WIKA Instrument Corp. Lawrenceville, GA	961420002	4/00
torque wrench (150 ft.-lb)	Stanley-Proto Covington, GA	WWE30966	6/99
torque wrench (100 ft.-lb)	Stanley-Proto Covington, GA	WUK50305	7/99
torque wrench (50 in.-lb)	Stanley-Proto Covington, GA	5A98	N/A (new)
torque wrench (200 in.-lb)	Stanley-Proto Covington, GA	WYC22958	N/A (new)

*Note. Equipment is calibrated in accordance with International Safe Transit Association test equipment verification requirements.*

**Part 5. Equipment** (continued)

<b>Item</b>	<b>Manufacturer</b>	<b>Serial</b>	<b>Calibration</b>
		<b>No.</b>	<b>Expiration</b> <b>Date</b>
400 kPa pressure gauge	Ashcroft Stratford, CT	45323-016A	11/00
400 kPa pressure gauge	Ashcroft Stratford, CT	5323-016B	11/00
100 kPa pressure gauge	Ashcroft Stratford, CT	59694-011B	11/00
100 kPa pressure gauge	Ashcroft Stratford, CT	59695-011A	11/00
semi-automatic plastic pail closer	Atlanta Grotnes Atlanta, GA	44833	N/A

## Appendix A

### Test Applicability

Based on the drop height and computed stacking weight, this test report is applicable for all surface modes of transportation (road, rail, and water), as well as both cargo and passenger air, when the solid hazardous substance intended for containment by the tested packaging is as described in this report. Transportation by commercial (cargo and passenger) or military air is as permitted by regulation for the hazardous item. The appropriate packaging paragraph for the lading applies. **Transportation of liquids is not authorized.**

Pass/fail conclusions were based on the particular box specimens, test loads, and the limited quantities submitted for test. Extrapolation to other materials, other manufacturers, other applications, different inner packagings, container sizes, or lesser inner quantities is the responsibility of the packaging design agency or applicable higher headquarters. Extrapolation of test results based on less than the minimum recommended number of test specimens is also the responsibility of the packaging design agency or applicable higher headquarters.

Reference to specification materials has been made based either on the information provided by the requester, the manufacturer, or the markings printed on, attached to, or embossed on the packagings. It was not possible to identify the exact composition of the box construction materials.

Testing was performed per *Title 49 Code of Federal Regulations; Subtitle B, Other Regulations; Chapter I, Research and Special Programs Administration (DOT); Subchapter C, Hazardous Materials Regulations; Part 173, Shippers- General Requirements for Shipments and Packagings; Part 173 Subpart A, General; as well as, Part 178, Specifications for Packagings; and Part 178 Subpart M, Testing of Non-Bulk Packagings and Packages.*

Performance testing was undertaken and completed at the request of an agency responsible for shipment of the dangerous good(s). The completion of successful required performance tests does not, by itself, authorize the marking and transportation of the dangerous good(s). Applicable modal regulations should be consulted concerning the relationship of performance testing completed and the dangerous good(s).

The required performance tests are intended to evaluate the performance of the packaging components. The criteria used to

**Appendix A** (Continued)

evaluate packaging performance is whether the contents of the packaging are retained within the outer packaging, should damage to the outer packaging occur, and secondly, if any inner packaging of hazardous materials leaks, ruptures, or is damaged so as to affect transportation safety. The successful completion of the required tests does not ensure the undamaged delivery or survivability of the actual commodity/item. Separate testing is necessary to assure the stability of any explosive item.

Before a configuration can be certified by the person(s) authorizing shipment, the appropriate packaging for the particular hazardous lading and mode of transportation must be determined, and the item(s) must be prepared for shipment per applicable regulations. The chosen configuration must have been performance tested in accordance with the size, the shape, and the weight constraints posed by the configuration to be certified. The testing reported herein should not be construed as blanket certification of any configuration that simply uses the performance tested box. Packaging paragraphs apply.

**Appendix B**

**Test Data Sheet**

**Section I. Test Product**

Physical State:   X   solid        liquid        gas        aerosol

Test Product(s) Used: Dry cell batteries; BA-270/U  
7¾ in. high; 2¾ in. wide; 2¼ in. deep  
18 qty

Test Product Density/Specific Gravity: N/A

Amount Per Container (Configuration):  
55 lb (55 lb) [Gross Weight - Tare Weight of Packaging]

Equivalent Amount per Container: N/A

Test Weight: ~26 kg

Gross Weight: 57 lb (Gross Weight = Test Weight x 2.205 lb/kg, rounded)

Consistency/Viscosity: N/A Flash Point: N/A

Additional Description: The single batteries were not packaged. A paperboard exterior surrounded each battery, which had open terminals for attaching cables. Each battery was inside a heat-sealed polyethylene bag. Fiberboard was used to fill void space.

## Appendix B

### Section II. Test Parameters

**Drop Height:** Ref: 49 CFR §178.603

- ☒ **1.8 m;** 71 in. (PG I, II, & III,  $SG \leq 1.2$  or **solids**)  
☐ 1.2 m; 47 in. (PG II & III,  $SG \leq 1.2$  or solids)  
☐ 0.8 m; 32 in. (PG III,  $SG \leq 1.2$  or solids)  
☐ \_\_\_\_ m; \_\_\_\_ in. (other, PG \_\_\_\_,  $SG$  \_\_\_\_)  
 from-- PG I:  $SG \times 1.5$  m,  $SG \times 59.06$  in.  
           PG II:  $SG \times 1.0$  m,  $SG \times 39.37$  in.  
           PG III:  $SG \times 0.67$  m,  $SG \times 26.38$  in.

Unless otherwise computed for more dense liquids, water ( $SG = 1$ ) represents a solution having a specific gravity of 1.2 or less. Equivalent specific gravity derived from drop height as follows--

PG factor  $\times$  density (or  $SG$ ) = drop height, thus  
 $SG = \text{drop height} / \text{PG factor}$  (49 CFR §178.603)  
 $0.67 \text{ m} \times SG = 1.8 \text{ m}$ , thus  $SG = 2.7$ , PG III

#### Internal Pressure/Hydrostatic Pressure (liquids only):

- ☐ N/A; surface only [49 CFR §178.605(a)]  
☒ **N/A; solids** [49 CFR §178.605(a)]  
☐ 250 kPa (36 psi); PG I single minimum  
           [49 CFR §178.605(d)(3), surface & 49 CFR §173.27(c)(3)(ii), air]  
☐ 100 kPa (15 psi); PG II/III single minimum  
           [49 CFR §178.605(d)(3), surface & 49 CFR §173.27(c)(3)(ii), air]  
☐ 80 kPa (12 psi); PG III of Class 3 or Division 6.1 sgl min.  
           [49 CFR §173.27(c)(3)(ii), air]  
☐ 95 kPa (14 psi); inner/supplementary minimum, PG N/A  
           [49 CFR §173.27(c)(2)(i), air]  
☐ 75 kPa (11 psi); inner/suppl. min., PG III of Cl 3/Div 6.1  
           [49 CFR §173.27(c)(2)(i), air]  
☐ 15 psi/103.4 kPa; other, drum specification [MIL-D-6054]  
☐ \_\_\_\_ kPa/\_\_\_\_ psi; other, \_\_\_\_\_

**Stacking Weight/Force** (continued): Ref: 49 CFR §178.606

**Solids--**  $A = (n-1)(w)(.95)$

where: A = applies load in pounds

n = minimum number of containers that when stacked,  
 reach a height of 3 m (round up to next integer)

w = maximum weight of one packed container in pounds

.95 corresponds to maximum fill (95% max. capacity)

- 513 lb minimum required; 600 lbf actual  
 $A = (n-1)(w)(.95)$   
 where: n = (118 in./12.5 in.)  
           = 9.4 rounded up to 10  
           w = 57 lb (presumed to be 95%)  
 $A = (10-1)(57) \approx 513 \text{ lb}$

## Appendix B (Continued)

## Section II. Test Parameters (continued)

Stacking Weight/Dynamic Compression Force: Ref: 49 CFR §178.606

**Liquids--**  $A = (n-1)[w + (s)(v)(8.3)(.98)](c)$ 

where: A = applied load in pounds

n = minimum number of containers that when stacked,  
reach a height of 3 m (round up to next integer)

s = specific gravity of lading

w = maximum weight of one empty container in pounds

v = actual capacity of container  
(rated capacity + outage) in gallons

8.3 corresponds to the weight (lb) of 1 gallon of water

.98 corresponds to maximum fill (98% max. capacity)

c = either 1.5 (the compensation factor that converts  
the static load of the stacking test into a load  
suitable for dynamic compression testing), or  
1.0 (static top load)N/A lb **minimum required (PG I, SG 1.2);** N/A lbf actual $A = (n-1)[w + (s)(v)(8.3)(.98)](c)$ 

where: n = (118 in./ in.)

≈ rounded up to

w = + ( )( ) + ≈ lb

s = 1.2

v = ( gal)( ) ≈ gal

c =

 $A = ( -1)[ + (1.2)( )(8.3)(.98)]( ) ≈$  lbN/A lb **minimum required (PG II, SG 1.8);** N/A lbf actual $A = (n-1)[w + (s)(v)(8.3)(.98)](c)$ 

where: n = (118 in./ in.)

≈ rounded up to

w = + ( )( ) + ≈ lb

s = 1.8

v = ( gal)( ) ≈ gal

c =

 $A = ( -1)[ + (1.8)( )(8.3)(.98)]( ) ≈$  lbN/A lb **minimum required (PG III, SG 2.7);** N/A lbf actual $A = (n-1)[w + (s)(v)(8.3)(.98)](c)$ 

where: n = (118 in./ in.)

≈ rounded up to

w = + ( )( ) + ≈ lb

s = 2.7

v = ( gal)( ) ≈ gal

c =

 $A = ( -1)[ + (2.7)( )(8.3)(.98)]( ) ≈$  lb

**Appendix B (Continued)****Section III. Equivalencies of Liquids - N/A**

	Specific Gravity <sup>1</sup>	Total lb per Configuration	Total lb per Container	Gross Weight (pounds) <sup>2</sup>	Test Weight (kilograms) <sup>2</sup>
water	1.0	----	----	---	----
PG I	1.2	----	----	---	----
PG II	1.8	----	----	---	----
PG III	2.7	----	----	---	----

Note 1. Equivalent specific gravity derived from drop height as follows-- PG factor x density (or SG) = drop height, thus

SG = drop height/PG factor (49 CFR §178.603)

PG I: 1.5 m x SG = 1.8 m, thus SG = 1.2

PG II: 1.0 m x SG = 1.8 m, thus SG = 1.8

PG III: 0.67 m x SG = 1.8 m, thus SG = 2.7

Unless otherwise computed for more dense liquids, water (SG = 1) represents a solution having a specific gravity of 1.2 or less.

Note 2. Gross and test weights include packaging (---- lb, ---- kg) and liquid contents. Gross Weight = Test Weight x 2.205 lb/kg, rounded.



**Appendix C**

**Packaging Data Sheet**

**Section I. Exterior Shipping Container**

Packaging Category: \_\_\_\_ single X combination \_\_\_\_ composite

UN Type: Fiberboard boxes (49 CFR §178.516) UN Code: 4G

Specification Type(s):

- (1) Fabrication of Fiberboard Shipping Boxes
- (2) Corrugated and Solid Fiberboard Sheet Stock (Container Grade) and Cut Shapes
- (3) Box, Shipping, Fiberboard (canceled Mar 94)
- (4) Fiberboard: Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes (canceled Mar 94)

Specification Number(s):

- (1) Equivalent to-- ASTM D 5118, style RSC (regular slotted container)
- (2) Equivalent to-- ASTM D 4727, grade V3c, type CF, variety SW, class WR
- (3) PPP-B-636 (marked), style RSC [canceled Mar 94]
- (4) Equivalent to-- PPP-F-320 (marked), type CF (corrugated fiberboard), variety SW (singlewall), grade V3c (marked), class WR (weather-resistant (marked)) [canceled Mar 94]

Container Manufacturer: Department of Defense  
Defense Distribution Depot Tobyhanna  
Tobyhanna, PA 18466

Date(s) of Manufacture: 5/99 (box); 3/92 (fiberboard (marked))

Manufacturer's Reference Number(s): N/A

Material: Corrugated fiberboard, stapled manufacturer's joint

Boxmaker's Seal: Tobyhanna Army Depot  
Tobyhanna, PA

"bursting test 350 lbs per sq inch"

"min comb wt facings 180 lbs per sq in"

"size limit 100 inches"

"gross wt lt 120 lbs"

"min. avg. burst. stgth. in excess of \_\_\_\_ lbs. p.s.i." - N/A

NSN: N/A

Tare Weight: 2 lb

Dimensions: 12 in. by 12 in. by 12 in. (ID)

Box Contract No(s): N/A

Box Purchase Order No(s): N/A

**Appendix C** (Continued)

**Section I. Exterior Shipping Container** (continued)

Closure Specification(s): ASTM D 1974, Methods of Closing,  
Sealing, and Reinforcing Fiberboard Shipping Containers

Closure Type: Pressure-sensitive, film-backed tape

Closure Type Specification(s):

- (1) Tested-- Commercial Item Description  
Tape, Film, Pressure-Sensitive Adhesive, (Box Closure)  
[canceled Dec 95]
- (2) Equivalent to-- FED SPEC  
Tape: Packaging, Waterproof [canceled Dec 95]
- (3) Equivalent to-- ASTM Specification for Pressure-Sensitive  
Tape for Packaging, Box Closure and Sealing

Closure Type Specification Number(s):

- (1) A-A-1830A (marked) [canceled Dec 95]
- (2) PPP-T-60, type III (film backing), class 2 (transparent)  
[canceled Dec 95]
- (3) ASTM D 5486, type I (waterproof, weather-resistant, polyester-backed),  
class 2 (transparent)

Closure Type NSN: 7510-00-266-6715

Closure Method: Tape applied over all seams, corners, and  
joints of the box. Tape applied to the manufacturer's joint  
shall cover the joint, but not extend beyond the corners. The  
tape applied to the seams shall be centered over the seams and  
shall extend over the corners and edges of the box a minimum  
of 2½ inches onto the adjacent box panels.

Closure Method Specification: ASTM D 1974 *sealing method B*;  
formerly method V, PPP-B-636 appendix (7-strip method)

Closure Dimensions: 2-inch (tape width)

Closure Manufacturer/Distributor:

American Tape	SETAPE, INC.
Secaucus, NJ (core marked)	Jacksonville, FL (wrapper marked)

Closure Contract No.: GS-141-63159 (box marked)

Closure Purchase Order No.: A-W-LE486-9E (box marked)

Closure Date of Manufacture: 2/97 (marked)

**Appendix C (Continued)**

**Section I. Exterior Shipping Container (continued)**

Reinforcement Type(s): Tape Banding

Reinforcement Specification(s) and Number(s): ASTM D 1974,  
Methods of Closing, Sealing, and Reinforcing Fiberboard  
Shipping Containers

Reinforcement Specification Method No(s): ASTM D 1974,  
modified Reinforcement Method 2B (see Reinforcement Method)

Reinforcement Method(s): Tape applied 1 inch from each end of  
the box. Bands shall overlap onto themselves at least  
3 inches. *Modifications-- 1-inch-wide tape used instead of  
3/4-inch-wide tape; four bands instead of one band; medium  
tensile tape used instead of high tensile tape; bands positioned  
2 inches in from ends, in lieu of 1 inch (3/4" HIGH TENSILE RECOMMENDED).*

Banding Specification Type(s):

- (1) Tested (marked)-- Commercial Item Description  
Tape, Pressure-Sensitive Adhesive, (Medium Tensile  
Strength, Glass Filament, Reinforced Tape) [canceled Jan 96]
- (2) Equivalent to-- FED SPEC  
Tape, Packaging/Industrial, Filament Reinforced [canceled Jan 96]
- (3) Equivalent to-- ASTM Standard Specification for  
Pressure-Sensitive Tape for Packaging, Filament-Reinforced

Banding Specification Number(s): NSN: 7510-00-582-4772

- (1) A-A-1687B, Amendment 1 (marked) [canceled Jan 96]
- (2) PPP-T-97, type II (medium tensile), class B (transparent) [canceled Jan 96]
- (3) ASTM D 5330-93, type II (medium tensile)

Banding Position(s): See Additional Description

- 2 girthwise tape bands, *encircling top, bottom, and sides,*  
2 inches in from each end
- 2 lengthwise tape bands, *encircling top, bottom, and ends,*  
2 inches in from each side
- 0 horizontal tape band, *encircling sides and ends,*  
       inches from top/bottom (*centered around box body*)

Banding Dimensions: 1 inch wide

Banding Manufacturer(s):

RJM MFG./TARA TAPE (box marked)  
TARA TAPE (wrapper marked)  
Fairless Hills, PA 19030

Banding Contract No.: TC-GS-14F-63238  
Purchase Order No.: A-W-LC337-5E

Banding Date of Manufacture: 12/96 (box marked)

**Appendix C (Continued)**

**Section I. Exterior Shipping Container (continued)**

Cushioning/Dunnage: fiberboard pad(s) [qty 1]

Cushioning/Dunnage Specification Type(s):

Fiberboard-- Standard Specification for Corrugated and Solid  
Fiberboard Sheet Stock (Container Grade) and Cut Shapes

Cushioning/Dunnage Specification Number(s):

Fiberboard-- ASTM D 4727, type CF (corrugated fiberboard)  
variety SW (singlewall), C flute  
class WR (weather-resistant)  
grade V3c

Cushioning/Dunnage Dimensions: see Additional Description

Fiberboard-- 12 in. by 12 in. (top pad, qty 1)

Cushioning/Dunnage Manufacturer(s):

Fiberboard-- Not identified

Leakproof Liner: N/A

*Note. For articles, in lieu of a plastic bag (liner) encompassing the entire load, it is recommended that each package be enclosed in an individual plastic bag (liner). In the unlikely event of damage to an inner package, the entire load will not be contaminated.*

Liner Manufacturer/Distributor and Part No.(s): N/A

Static Electricity Protection: **To be determined**

Additional Description: a. **Whenever a barrier bag is used, to prevent puncturing the barrier bag, a piece of tape must cover the staples and manufacture's joint on the inside of the outer fiberboard box.**

b. Before cancellation, PPP-B-636 specified that *horizontal* reinforcing tape bands (*encircling the box sides and ends*), are not required when the box depth (height) is less than but not equal to 18 inches. Experience has demonstrated that manufacturers' joints on large/tall boxes of solids have the potential to fail if horizontal reinforcing tape banding is not applied.

c. Before cancellation, PPP-B-636 specified that one *girthwise* reinforcing tape band (*encircling the box top, bottom, and sides*), is required when the box length is less than but not equal to 20 inches. Two reinforcing tape bands in the girthwise direction were used per instructions from the requesting organization.

**Appendix C** (Continued)

**Section I. Exterior Shipping Container** (continued)

d. Before cancellation, PPP-B-636 specified that one *lengthwise* reinforcing tape band (*encircling the box top, bottom, and ends*) is required when the box width is greater than 9 inches and less than 18 inches. Per instructions from the requesting activity, two lengthwise reinforcing tape bands were used.

e. ASTM D 1974 recommends that, when used, tape bands shall be placed around the length (smallest circumference) of the box with at least one band for each 15 inches of box length.

f. Prior to 3 March 1994, PPP-B-636 specified the construction, closing, and reinforcing of fiberboard boxes, while PPP-F-320 specified the fiberboard. Both FED-SPECS have been canceled and replaced with ASTM documents. ASTM D 4727 is the specification for fiberboard; ASTM D 5118 is the practice for fabricating fiberboard boxes; and ASTM D 1974 is the practice for closing, sealing, and reinforcing fiberboard boxes. The three ASTM documents almost mirror the two FED SPECS with the most notable exception being that PPP-B-636 provided tables for when and what size reinforcement was to be specified. ASTM D 1974 does not recommend comparable reinforcements.

**Appendix C (Continued)**

**Section II. Primary Inner Packaging of Combination Packaging**  
**Applicable/~~Not applicable~~**

Quantity of Inner Containers: TBD Capacity: TBD

Specification Type and Nos.: N/A

Dimensions: 7¾ in. high; 2¾ in. wide; 2¾ in. deep

Type/Materials: Packaged solids (batteries)

Manufacturer/Distributor: N/A Date(s) of Manufacture: N/A

NSN: N/A

Tare Weight: N/A Filled Weight: ~3 lb per battery

Closure (Method/Type): N/A

Closure Spec. No(s).: N/A

Closure Manufacturer: N/A

Closure Dimensions: N/A Secondary Closure: N/A

Secondary Closure Specification Type(s) and No(s).: N/A

Secondary Closure Dimensions: N/A

Secondary Closure Manufacturer(s): N/A

Cushioning/Dunnage Type and Dimensions: N/A

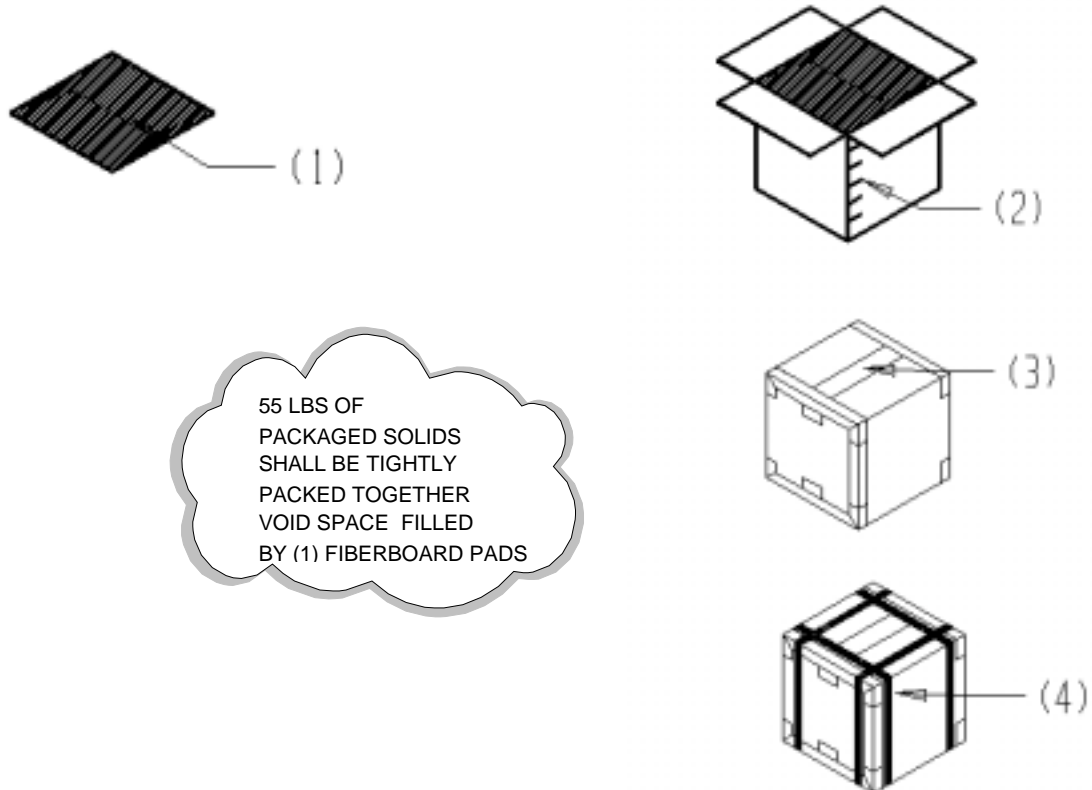
Cushioning/Dunnage Specification and No(s).: N/A

Cushioning/Dunnage Manufacturer: N/A

Leakproof Liner: N/A Static Electricity Protection: N/A

Additional Description: The test load consisted of old, dry cell batteries. Each battery was enclosed in a paperboard case. Each battery was in a heat-sealed polyethylene bag.

*Note 1. A sealed article satisfies the requirements of the inner packaging associated with the applicable packing paragraph. Reference: 49 CFR §178.601(g)(6)*

**Appendix C (Continued)****Section III. Drawing**

ITEM	DESCRIPTION	99AYP003
NOTE	LITHIUM BATTERIES SHALL BE PACKAGED IAW MIL-B-49430, i.e., EACH IN A CHIPBOARD/PAPERBOARD BOX, SEALED IN A POLYETHYLENE BAG	
1	FIBERBOARD, GRADE W5c OR V3c IAW ASTM D 4727, TOP PAD, 12 X 12 IN.; CUT SIZES TO FIT VOIDS	
2	FIBERBOARD BOX, 12 x 12 x 12 IN. (ID), ASTM D 5118, STYLE RSC WITH STAPLED JOINT; GRADE V3c IAW ASTM D 4727	
3	7 STRIPS PRESSURE-SENSITIVE ADHESIVE TAPE, 2-IN. WIDE, IAW ASTM D 5486, TY I (FILM-BACKED, NSN 7510-00-266-6715), or TY V (PAPER-BACKED, NSN 7510-00-297-6655)	
4	PRESSURE-SENSITIVE ADHESIVE TAPE, FILAMENT-REINFORCED, IAW ASTM D 5330, ¾-IN. WIDE, TY IV (HIGH TENSILE, NSN 7510-00-584-5785, RECOMMENDED), or 1-IN. WIDE, TY II (MEDIUM TENSILE, NSN 7510-00-582-4772); 2 GIRTHWISE BANDS, 2 LENGTHWISE BANDS, 2 IN. IN FROM ENDS	

## Appendix D

### Rationale

The equivalent of Packing Group I (great danger) testing was requested for a corrugated fiberboard box having as the intended contents packaged solids, which would typically be lithium batteries. Per MIL-B-49430, each lithium battery is to be individually packaged in a paperboard box and a heat-sealed polyethylene bag.

Whenever the dimensions of the actual item are close enough to the dimensions of the tested configuration, variation 4 for selective testing can be invoked. This variation to testing requirement, found in 49 CFR §178.601(g)(4), authorizes each external dimension (length, width, height) to be less than or equal to the corresponding dimension of the design type. This allows lessening of the dimensions to provide a snug fit around the item(s). The tested weight is to be greater than the intended weight for any item. Per 49 CFR §178.601(g)(6), the provisions of variation 4 may be applied to articles rather than just inner packagings.

Old, dry cell batteries (BA-270/U) were used as a test load. The batteries had been in storage for more than 10 years. For testing, substitution for actual hazardous lading is permitted by 49 CFR §178.602(b) and (c). The batteries were used to achieve the desired weight.

The articles (batteries) were placed in a snug-fitting, corrugated fiberboard box, which was sealed using seven strips of pressure-sensitive adhesive, film-backed tape. The box was reinforced with two girthwise bands of pressure-sensitive adhesive, filament-reinforced tape, encircling the box top, bottom, and sides. The box was also reinforced with two lengthwise bands of pressure-sensitive adhesive, filament-reinforced tape, encircling the box top, bottom, and ends. The box was not reinforced with a centered horizontal band of pressure-sensitive adhesive, filament-reinforced tape, encircling the box sides and ends. A fiberboard top pad was used. A plastic bag, encompassing the entire load (batteries) was not included.

One combination packaging (batteries in a box) made to the above described configuration was subjected to drop and vibration testing as prescribed in ASTM D 4919. These tests are designed to simulate the shock and vibration a package (configuration) may encounter when being shipped worldwide by truck, rail, or ocean going transport. The order of testing was vibration, then drop testing. After the rough handling testing of the packed box, static loading was performed on an empty box. This is a U.S. DOT approved method of stack testing, especially when the combination packaging has wide applications. Other boxes were used for water absorptiveness testing of the fiberboard.



**Appendix D (Continued)**

In conducting the drop test, all five drops (flat bottom, flat top, flat long side, flat short side, and bottom joint corner) were originally to be performed on the same configuration. The decision to use the same container (configuration) for all five drop orientations was based on the relatively minimal damage demonstrated during previous testing of weather-resistant fiberboard boxes with different inner containers or articles. It should be noted that five drops per box exceeds 49 CFR requirements. One drop per box is the **minimum** per 49 CFR requirements (49 CFR §178.603(a)), as well as, per both UN and ASTM recommendations (i.e., one drop on a side or corner per box). The use of one configuration for multiple tests and drops is DOD policy as stated in DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/MCO 4030.40A, Packaging of Hazardous Material. Also per this policy, any failed orientation(s) can be repeated using another configuration.

For each orientation for the drop test (49 CFR §178.603), a free fall drop table, set for 1.8 meters (71 in.), was used. The impact surface was the ½-inch steel impact plate of the table, which was bolted to the concrete floor.

The leakproofness test (49 CFR §178.604) was not conducted on the box, because the box is an outer packaging of a combination packaging, and is not intended for the containment of liquids. Leakproofness testing is not required for configurations of solids.

For internal pressure requirements for liquids in inner packagings of combination packagings intended for transportation by aircraft, 49 CFR §173.27(c) applies. Pressure requirements, for lading other than liquids, have not been identified. Testing for the maintenance of internal pressure is not required for configurations of solids.

For the stack test (49 CFR §178.606), a 5,000-lb capacity compression tester was used because it could hold the load constant for the required 24-hour timeframe. The total top load to be applied was greater than the minimum required for one box based on the outside box height and the gross packaged weight. The top load was to simulate a stack of identical packagings which might be stacked on the packaging during transport. The minimum height of the stack could not be less than 3 meters (118 in.), so the number of packagings (stack height minimum divided by assembled box height) had to be represented by an integer number, which had to be rounded up, without respect to which was the nearest whole number.

To be in compliance with U.S. Department of Transportation standards for packagings bearing the United States mark (USA) as a component of the packaging certification marking (49 CFR §173.24a(a)(5)), the vibration test (49 CFR §178.608) was performed, as a means to

**Appendix D (Continued)**

determine capability. The test was conducted as prescribed by ASTM D 999, method A2 (Repetitive Shock Test (Rotary Motion)). The test was run for 1 hour, using the packed combination packaging. The combination packaging was tested using a 1,250-lb capacity vibration table (rotary motion) that had a 1-inch-vertical double amplitude (peak-to-peak displacement) such that the combination packaging was raised from the platform to such a degree that a piece of steel strapping (1.6 mm) could be passed between the bottom of the package and the platform.

As required by the standards for fiberboard boxes (49 *CFR* §178.516), the Cobb Method Test for water absorptiveness was to be performed on specimens (125 mm by 125 mm) cut from either the box used for rough handling (drop, stack, and vibration) testing, or from a sample of the fiberboard sheet stock used to make the box. This test was performed per TAPPI Method T 441 using specimens cut from three boxes which had been used for the rough handling tests. The apparatus used was a commercially available Cobb Sizing Tester. The volume of deionized water was computed to maintain an equivalent head of  $1.0 \pm 0.1$  centimeter. Since boxes are occasionally made with the wire facing (interior) as the exterior side of the box, specimens from both the wire (interior) and the felt (exterior) facings should be tested for water absorptiveness. Ten exterior specimens were tested. It should be noted that improper storage and rough handling may break the fibers and abrade the coating of the box, decreasing its ability to resist water absorption. This could result in higher test values.

Compatibility testing (a procedure specified in appendix B to part 173, as required by 49 *CFR* §173.24(e)(3)(ii)) is only required for plastics packagings intended to contain liquid hazardous materials.

**Appendix E****Actual Product**

Note. The item Identification Number and related Proper Shipping Name have not been identified for items to be transported in this configuration.

Name: Explosive No.:

Part No.: Drawing No.:

NSN: Type: DODIC:

Specification: RELCD:

Properties or Descriptions:  
(IMO IMDG)

Proper Shipping Name(s):  
49 CFR--  
IATA/ICAO DGR--  
AFJMAN 24-204/TM38-250--  
IMO IMDG--

Identification No.: UN Hazard Class or Division:

Packing Group: \_\_\_ I \_\_\_ II \_\_\_ III

49 CFR-- Packaging Authorization(s): §  
Exception(s): §  
Special Provisions:

IS/IS NOT forbidden on passenger aircraft/rail  
kg maximum limitation  
IS/IS NOT forbidden on cargo air,  
kg gross maximum limitation

ICAO TI/IATA DGR--

Packing Instruction(s): passenger aircraft--  
cargo aircraft--

Special Provisions:

IS/IS NOT forbidden by passenger air, \_\_\_ kg maximum limit  
IS/IS NOT forbidden by cargo air, \_\_\_ kg G max. limitation

IATA State Variations:

IATA Operator Variations:

IMO IMDG Code Packagings: Schedule , stowage  
Packing Method

**Appendix E** (Continued)

NSN (continued):

AFJMAN 24-204/TM 38-250--

Packaging Paragraph:

Special Provisions:

WAS/WAS NOT a theta item (duty passengers)

WAS/WAS NOT a dagger item (no passengers)

Note. The theta/dagger designations were eliminated in the 1 Mar 97 revision to AFJM 24-204, and replaced with Special Provisions codes.

Amount Per Container (Configuration): \_\_\_\_\_ gallons

Net Explosive Weight:           kg each  
                                  kg total

Density/Specific Gravity:

Vapor Pressure at 50° C:  
                          55° C:  
                          70° F:                   mm Hg

Flash Point:   \_\_\_ N/A       \_\_\_ ° C   \_\_\_ ° F

Consistency/Viscosity: N/A

Interim Hazard Classification Ref(s): N/A

Electrostatic Discharge Protection: Required/not required

Shelf Life Item?   \_\_\_ Yes   \_\_\_ No

Additional Description: N/A